

# इंटरनेट

# मानक

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IS 8198-7 (1988): Code of practice for steel cylinders for compressed gases, Part 7: Ammonia gas [MED 16: Gas Cylinders]



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“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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*Indian Standard*  
**CODE OF PRACTICE FOR STEEL CYLINDERS**  
**FOR COMPRESSED GASES**  
**PART 7 AMMONIA GAS**  
*( First Revision )*

**1. Scope** — Covers filling, inspection, testing, maintenance and use of portable steel cylinders for the storage and transportation of liquefied ammonia gas in cylinders, of nominal capacity up to and including 130 litres water capacity.

**2. Terminology** — For the purpose of this standard, the definitions given in IS : 7241-1981 'Glossary of terms used in gas cylinder technology ( *first revision* )' shall apply.

**3. Properties and Physical Constants**

**3.1** The properties and physical constants of ammonia gas are described in Table 1. The vapour pressure of ammonia at different temperatures is given in Table 2.

**TABLE 1 PROPERTIES AND PHYSICAL CONSTANTS OF AMMONIA**

| Physical Classification                         | Low Pressure Liquefiable,<br>Non-flammable<br>But Supports Combustion |
|---|---|
| Auto-ignition temperature                       | 651°C   |
| Affinity for water                              | Yes   |
| Boiling point at 760 Torr                       | -33.4°C   |
| Colour  | Colourless  |
| Odour   | Pungent   |
| Melting point                                   | -77.7°C   |
| Light sensitivity:                              | No  |
| a) Vapour density at 0°C and 1 atm ( air = 1 )  | 0.597   |
| b) Liquid density at boiling point and 760 Torr | 0.674 g/ml  |
| c) Liquid density at 15°C                       | 0.617 g/ml  |
| Molecular mass                                  | 17.03   |
| Critical temperature                            | 132.4°C   |
| Critical pressure                               | 116.5 kgf/cm <sup>2</sup> ( abs )                                     |
| Critical density                                | 0.235 g/ml  |
| Solubility in:                                  |   |
| a) Water  | 47.3 percent by mass  |
| b) Methanol absolute                            | 29.3 percent by mass  |
| c) Ethanol absolute                             | 20.95 percent by mass   |

**TABLE 2 VAPOUR PRESSURE OF ANHYDROUS AMMONIA**

| Temperature<br>°C | Vapour Pressure<br>kgf/cm <sup>2</sup> | Temperature<br>°C | Vapour Pressure<br>kgf/cm <sup>2</sup> |
|-------------------|--|-------------------|--|
| -60               | 0.42                                   | 55                | 23.6                                   |
| -40               | 0.73                                   | 60                | 26.6                                   |
| -30               | 1.22                                   | 65                | 29.04                                  |
| -20               | 1.89                                   | 70                | 33.7                                   |
| 10                | 2.93                                   | 75                | 37.7                                   |
| 0                 | 4.52                                   | 80                | 42.1                                   |
| 5                 | 5.35                                   | 85                | 47.5                                   |
| 10                | 6.21                                   | 90                | 52.1                                   |
| 15                | 7.00                                   | 95                | 58.1                                   |
| 20                | 8.72                                   | 100               | 63.5                                   |
| 25                | 10.2                                   | 105               | 70.4                                   |
| 30                | 11.8                                   | 110               | 77.3                                   |
| 35                | 13.7                                   | 115               | 84.6                                   |
| 40                | 15.7                                   | 120               | 92.7                                   |
| 45                | 17.9                                   | 125               | 107                                    |
| 50                | 20.6                                   | 130               | 111                                    |

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**3.2 Ignition Range in Air** — 15 to 30 percent by volume. This means that within this range of concentration, the gas is capable of forming mixtures with air in which at an initial temperature of 20°C and an initial pressure of 1 atmosphere, there is propagation of ignition, started by an ignition source.

**3.3 Maximum Permissible Toxicity** — 100 ppm by volume. ( This is the maximum concentration in air to which nearly all workers may be exposed day after day without adverse effects. ) Inhalation of air containing more than 5 000 ppm of ammonia may cause death. Permanent eye injury may result from exposure to 700 ppm concentrations for longer than 30 minutes.

**3.4 Chemical Reaction with Metals** — When dry, ammonia does not react with most of the metals. When mixed with even very little water, it vigorously attacks copper, zinc, silver and many alloys, especially those containing copper. Hence absolutely no brass or bronze valve fittings are to be used for ammonia cylinders. Fittings should be made of iron or steel since ammonia will not attack these materials.

### **4. Approved Specifications and General Guidance for Manufacture**

**4.1** The cylinders used for the storage and transportation of ammonia gas shall conform to one of the specifications approved by statutory authority. A list of approved specifications for filling in this country is available with the Chief Controller of Explosives, Nagpur.

**4.2** Cylinders manufactured in accordance with approved specifications shall be provided with an additional wall thickness to allow for corrosion during service. It shall be borne in mind that corrosion is not related to the thickness of the container so that any additional thickness allowed for corrosion should be constant rather than a given proportion of thickness.

**4.3** Further, additional wall thickness shall also be considered necessary in order that the cylinder can safely withstand stresses due to horizontal acceleration and retardation in normal road transportation. The cylinder shall be so designed that the maximum permissible equivalent stress will not be exceeded when the stresses in the cylinder due to vertical accelerations are super imposed upon the stress due to internal pressure. The vertical acceleration considered should be those occurring in normal road transport. The provisions to be made in these and other respects as well as manufacturing tolerances to be applied will generally be decided between the user and the manufacturer. If a pronounced departure from normal practice is proposed or if other unusual features arise, the statutory authority shall be consulted.

### **5. Inspection**

**5.1 Inspection During Manufacture** — One of the inspecting agents approved by the statutory authority shall visit the manufacturing works to check and verify the following.

**5.1.1** The chemical composition and physical properties of the steel used for the manufacture of cylinders strictly conform in all respects to the required specifications and that the chemical analysis of the material has been verified.

**5.1.2** A steel maker's guarantee certificate ensuring that the steel used for making the cylinder is manufactured in accordance with the approved process and is available with the manufacturer, and that the material used for making each cylinder has been examined by him and found to be sound in all respects.

**5.1.3** The mechanical properties, the wall thickness, inner and outer surfaces of the cylinders were found satisfactory and in accordance with the requirements.

**5.1.4** The length, capacity and mass of each cylinder were found within tolerance limit.

**5.1.5** The hydrostatic test for each cylinder has been witnessed and that the cylinder has passed the same [see 8.1 of IS : 7680-1985 Specification for welded low carbon steel gas cylinders for ammonia ( anhydrous ) gas ( *first revision* ) ].

**5.1.6** The heat treatment of the cylinders was supervised and found to be in conformity with the requirements.

**5.1.7** All cylinders which pass the above tests and accepted have been officially stamped by him.

**5.2 Inspection During Usage** — All the cylinders shall be examined for the following, when received for filling.

**5.2.1** The cylinders conform to one of the specifications approved by the statutory authority for use in this country.

**5.2.1.1** A cylinder, either not conforming to any of the standard specifications or when the specification is not known, shall not be accepted for filling, unless approved and cleared by the statutory authority.

**5.2.2** The statutory requirements regarding valves, markings, fittings and paintings are complied with.

**5.2.3** The external condition of the cylinder body is sound. Any defect, such as dent, bulge, cut, gauge corrosion, etc, which is liable to weaken the cylinder wall as certified by a competent person will render the cylinder unfit for further use. The acceptability limit of such damaged cylinder is detailed in IS : 5845-1984 'Code of practice for visual inspection of low pressure gas cylinders (*first revision*)'.

**5.2.4** The outlet threads of valves are in good condition. The spindle is sound and not broken, and the gland washers which shall be of good quality and compatible with ammonia are not worn out.

**5.2.5** The cylinder is not due for periodic inspection and testing as indicated from the markings on the cylinder.

**5.3 Periodic Inspection and Testing** — Cylinders shall be periodically tested and inspected as follows.

**5.3.1** All cylinders, when received for filling, shall be checked by the filler if they are due for the hydrostatic re-testing. Hydrostatic test shall be carried out in accordance with IS : 5844-1970 'Recommendations for hydrostatic stretch testing of compressed gas cylinders'.

**5.3.2** The cylinders are to be tested periodically as stipulated by the statutory authority (*see* IS : 8868-1978 Periodical inspection interval of gas cylinders in use ).

**5.3.3** The examination and testing of the cylinder shall be done by a competent person.

**5.3.4** All cylinders, whether new or in service, shall be carefully examined internally and externally for any damage. In case of suspected damage to the parent metal, all protective coatings and foreign matter, if any, shall be removed, where necessary, prior to such examination so that the surface can be properly examined. The damage, if any, shall be carefully ascertained, the acceptability limit of the same is detailed in IS : 5845-1984.

**5.3.5** The internal examination shall be conducted by an efficient electric lamp which will give adequate illumination to have a clear view so that the defect, if any, can be detected.

## **6. Disposal of Condemned Cylinders**

**6.1** Cylinders which do not comply with the requirements of inspection and testing shall be destroyed in accordance with IS : 9200-1988 'Methods of disposal of unserviceable compressed gas cylinders'.

**6.2** Record of such cylinders shall be closed and kept in for a period of one year.

## **7. Fittings**

**7.1** Cylinders shall be fitted with a valve conforming to either IS : 3224-1979 'Specification for valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders (*second revision*)' or to any other specification approved by the statutory authority.

**7.2** The cylinder shall have its valve protected against damage by the provision of a stout metal cap or shroud, securely attached to the body of the cylinder.

**7.3** Safety device, if provided, shall be properly maintained (*see also* IS : 5903-1970 Recommendations for safety devices for gas cylinders ).

**7.4** The colour of the paint on the cylinders [*see* IS : 4379-1981 Identification of contents of industrial gas cylinders (*first revision*) ] shall always be maintained by periodically repainting them.

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## 8. Filling

**8.1** While filling, the cylinder shall be filled in such a manner that the filling ratio does not exceed 0.51 [ see IS : 3710-1978 'Specification for filling, ratios for low pressure liquefiable gases contained in cylinders ( *first revision* )' ].

**8.2** The amount of anhydrous ammonia charged into each cylinder shall be determined by weighing after the cylinder has been disconnected from the line and on no account the cylinder shall be charged in excess of the filling ratio.

**8.3** All the cylinders shall be carefully examined for leaks after filling. Where leaks cannot be stopped, the cylinder shall be emptied and inspected for the cause of leakage.

**8.4** Emptying the cylinder shall not be accelerated by direct heating of the cylinder.

**8.5** Cylinders shall be filled in an approved filling station only.

**8.6** Filling staff shall identify the cylinders from their black ground colour and colour of band as signal red and golden yellow, and ammonia symbol  $\text{NH}_3$  ( see IS : 4379-1981 ) punched on the cylinder before proceeding to fill them. The colour coding shall be considered as secondary.

## 9. Marking and Labelling

### 9.1 Marking

**9.1.1 On cylinders** — Each cylinder shall be permanently marked on the valve end of the cylinder with the following markings:

- a) Serial number, identification and symbol of the manufacturer;
- b) Number of the standard to which the cylinder conforms;
- c) Test pressure;
- d) The date of hydrostatic test with code mark of the station where the test was carried out;
- e) Water capacity;
- f) Tare mass;
- g) Working pressure; and
- h) Ammonia symbol (  $\text{NH}_3$  ).

**9.1.2 On valves** — The following markings shall be made on cylinder valves:

- a) Number of the standard,
- b) Ammonia symbol (  $\text{NH}_3$  ),
- c) Test pressure, and
- d) Manufacturer's symbol and year of manufacture.

**9.2 Labelling** — Each filled cylinder shall carry an identifying label or stencil depicting the symbol given in Fig. 2 of IS : 1260 ( Part 1 )-1973 'Pictorial marking for handling and labelling of goods: Part 1 Dangerous goods ( *second revision* )'. The following information shall also be given.

### AMMONIA, ANHYDROUS

**Warning** — Hazardous liquid and gas under pressure liquid causes burns. Gas extremely irritating.

- a) Do not breathe gas.
- b) Do not get in eyes, on skin, on clothing.
- c) In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. Call a physician at once in case of burns, especially to the eyes, nose, throat or if the patient is unconscious.
- d) Keep cylinders away from heat and sun. Do not store with flammable or explosive materials.
- e) Never drop cylinders.
- f) Be sure that the connections are tight. Use no oil or lubricants on valves.
- g) Never refill cylinders.

**9.2.1** The other page of the label shall contain the details of cylinder, content of the cylinders, manufacturer of the content and details of filler.

## **10. Storage**

**10.1** Cylinders shall be stored in a dry ventilated place away from excessive heat or danger of fire, and protected from accumulation of snow and ice. It is preferable that cylinder storage room be fire-proof. The storage room shall not be used for any purpose other than the storage of cylinders.

**10.2** Ventilation shall be provided through the structure in such a manner that full advantage of natural ventilation may be obtained. If natural ventilation is not sufficient, then storage area shall be equipped with suitable type of mechanical ventilation.

**10.3** Pocketing of ammonia gas under floor roofs and similar structures shall be avoided.

**10.4** Locations used for storage of cylinders shall be cut off from other occupancies and the building protected with automatic sprinklers, vapour-tight electrical equipments, good natural ventilation, good floor drainage and adequate explosion venting.

**10.5** Cylinders shall never be stored near gangways or elevators or near ventilating systems.

**10.6** Dangers can be reduced by storing cylinders so that the oldest stock can be used first.

**10.7** Keeping the full and empty cylinders separately and storing in an orderly way will reduce the necessary handling and confusion and permit frequent inspection for signs of leaks or other dangers. Valve protection hoods shall always be kept in place except when cylinders are actually being emptied.

**10.8** Cylinders shall be stored in an upright position.

**10.9** Cylinders shall not be stored outdoor.

## **11. Handling**

**11.1** Adequate care shall be taken in handling the cylinders so that these are not dropped or struck against each other violently.

**11.2** Cylinders shall be moved on properly balanced hand trucks, preferably with rubber tyres. A clamp or chain support two-thirds of the way up the cylinder shall be used.

**11.3** Hoisting of cylinders is not recommended. However, if hoisting cannot be avoided, a lifting clamp cradle or carrier shall always be used. Ammonia cylinders shall never be hoisted with lifting magnet, rope or chain sling. A cylinder shall never be lifted by the hood as it is not strong enough to support the weight.

**11.4** The cylinders shall not be used as rollers to move other equipment.

**11.5** Travelling overhead hoists or specially equipped trucks and dollies may be used for moving the containers to storage or point of use.

## **12. Transportation**

**12.1** Cylinders may be shipped by truck, rail or water.

**12.2** Cylinders shall not be loaded on vehicles in such a manner that they may bounce or strike against each other.

**12.3** During transport, cylinders shall not project in the horizontal plane beyond the sides or ends of the vehicle.

**12.4** Cylinder on vehicle shall be blocked or braced and secured to prevent movement or falling down.

**12.5** There shall not be any sharp projections on the inside of the vehicle which can damage the cylinder wall.

**12.6** Leaky or defective cylinder shall not be transported.



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**12.7** When cylinders are transported by rail, it shall be done in accordance with the Railway Red Tariff Rules. Cylinder shall be pasted with label for dangerous and poisonous gas as recommended by the Railways.

**12.8** The transport contractor or the personnels involved for the transport of cylinders shall be informed of the special care that has to be taken for cylinders and shall be well informed about toxicity of the gas.

### **13. Removing Ammonia from Cylinders**

#### **13.1 Connections**

**13.1.1** Outlet threads on container valves shall not be tapered pipe threads. Connections shall be made with yoke and adopter.

**13.1.2** Stainless steel tube with minimum working pressure of 40 kgf/cm<sup>2</sup> shall be used for connections between cylinder and stationary piping.

**13.1.3** A shut-off valve suitable for liquid ammonia service shall be provided at the beginning of stationary piping to simplify changing of containers.

#### **13.2 Valves**

**13.2.1** To unseat the valve, end of the wrench shall be struck with the help of hand and then opened slowly.

**13.2.2** One complete turn permits maximum discharge. The valve shall not be forced beyond this point.

**13.2.3** If the valve is too tight to open, the packing gland nut shall be slightly loosened to free the stem.

**13.2.4** Large wrenches or pipe wrenches shall not be used on valve opening.

### **14. Discharge**

**14.1** The tube type cylinder is normally used in the horizontal position. Two general types of valves are supplied. Depending on which type is involved, either the valve outlet or the valve stem is kept at an angle with the longitudinal axis of the cylinder. The position of this valve outlet or stem determines whether liquid or gaseous ammonia will be discharged from the cylinder. When the valve outlet or stem is on top, the dip pipe on the inside of the cylinder is under the liquid, and, therefore, liquid anhydrous ammonia will be discharged. To discharge gaseous ammonia, the cylinder is turned so that the valve outlet or stem points downward. For this, instructions of the concerned ammonia manufacturer shall be followed.

**14.2** The bottle type or vertical type will discharge ammonia as a gas when placed in an upright or vertical position. Due to liquid ammonia expansion, a bottle type cylinder may, under certain elevated temperature conditions, discharge a small amount of liquid when the valve is opened. It is, therefore, recommended that bottle type cylinders be allowed to reach room temperature before the valve is opened. To discharge liquid anhydrous ammonia, this type of cylinder shall be placed in a horizontal position with the valve outlet pointed up.

**14.3** The rate at which gaseous ammonia may be discharged from either type cylinders depends upon the temperature of the surrounding atmosphere and the surface area of the liquid ammonia.

**14.4** When the cylinder is empty, it should be disconnected and the valve plug inserted and the cylinder protective cap replaced.

**14.5** If a bottle type cylinder has become frozen during discharge, a pry under the valve end shall never be used to loosen the cylinder. Instead water should be used to loosen the cylinder or one should wait for it to thaw out.

**14.6** Empty cylinders shall be stored separately from filled cylinders. An 'EMPTY' tag shall be fastened on cylinders immediately upon emptying. Then valve shall be closed, plug or nut on valve outlet replaced and valve protecting cap secured snugly.

## 15. Gas Flow

**15.1** The rate of gas flow can be increased by improving air circulation about the container or by increasing the room temperature if it is below normal.

**15.1.1** Heat shall not be applied directly to the cylinder for any reason.

**15.2** If a high rate of gas flow is required, ammonia shall be withdrawn as liquid and converted to gas by means of vaporizer.

**15.3** Joining together or manifolding of the outlets of several cylinders to increase the flow rate shall not be done.

**15.4** The amount of ammonia remaining in a cylinder shall be best found by comparing the mass of the cylinder with the tare mass when empty. If the container is placed on a scale during unloading, the amount remaining is known at all times.

**15.5** When ammonia is being absorbed in a liquid, there is sometimes a tendency for the liquid to be sucked back into the cylinder as it becomes empty. This may result in serious accidents.

**15.5.1** A vacuum break loop or device as indicated in Fig. 1 shall be employed whenever ammonia from cylinders is absorbed in a liquid.

## 16. General Precautions

**16.1** Cylinders shall be handled by properly instructed and trained persons.

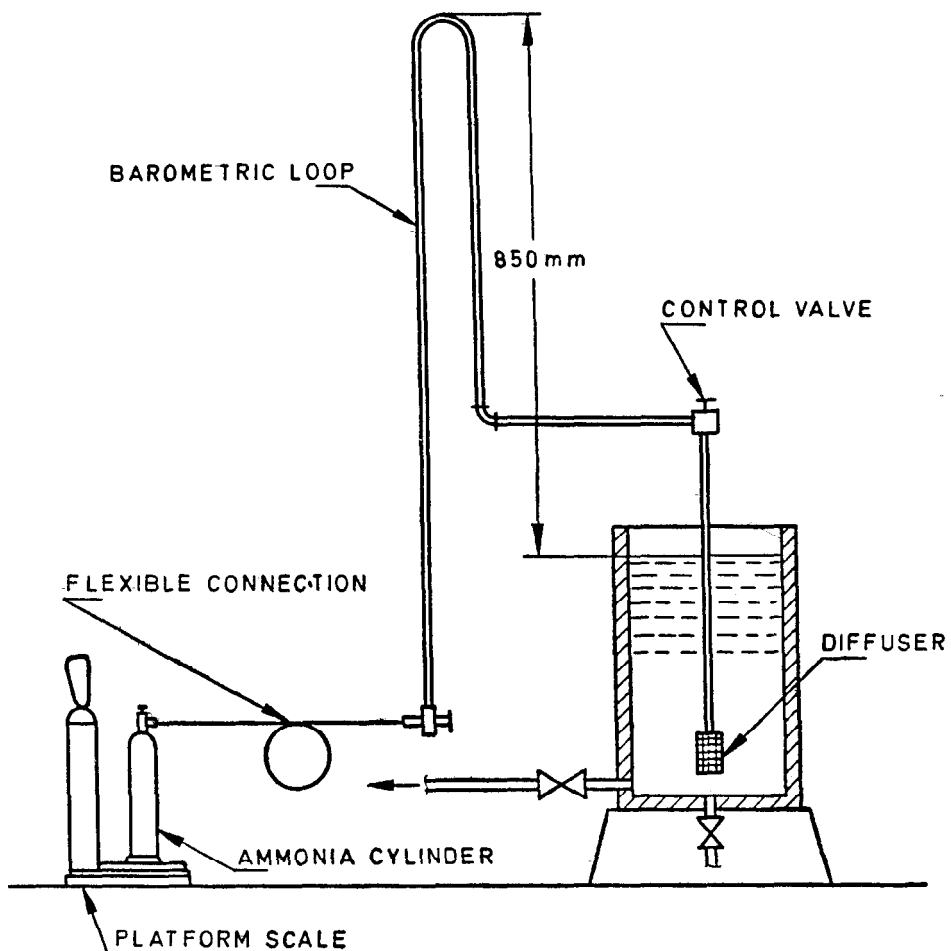


FIG. 1 VACUUM BRAKE DEVICE

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**16.2** Attempts shall never be made to remove the valve from the cylinder body except by competent persons fully conversant with the job.

**16.3** Cylinders with defects shall be immediately labelled appropriately and returned to the supplier.

**16.4** Marking and identification colour of a cylinder shall never be defaced.

**16.5** If any incident occurs to the cylinder, the supplier shall be immediately informed giving the cylinder number, nature of the damage and, if possible, the reasons for the incident.

**16.6** When there is a doubt in proper handling of the cylinder, the manufacturer or the supplier of the cylinder shall be consulted.

**16.7** The cylinder shall not be filled with any other gas.

### **17. Ammonia Leaks and Spills**

**17.1** Ammonia leaks shall always be taken care of immediately or they will become worse.

**17.2** Leaks of ammonia shall be searched for, preferably with hydrochloric acid solution or with either chlorine gas or sulphur dioxide gas, using a small cylinder of the compressed gas. A white cloud is produced in the presence of ammonia. Because of the fire risk, sulphur candles should not be used.

**17.3** If leaks or spills occur, only protected personnel should remain in the area. In case where leaks cannot be valved off, large volumes of water shall be sprayed directly on the leak and the contact maintained until the contents have been discharged. Leaking cylinders shall be removed to the outdoors or to an isolated well-ventilated area and the contents transferred to other suitable containers. All spills shall be flushed away promptly with water.

**17.4** Corrective measures shall be undertaken only by trained men wearing proper safety equipments.

**17.5** If the leak is large, all persons in the affected area shall be warned.

**17.6** If ammonia is leaking as liquid, the cylinder shall be turned so that the leaking side is on the top.

**17.7** Leaks around valve stem, valve discharge outlet shall be stopped by closing the valve or tightening the packing gland or replacing gaskets.

**17.8** A leaking container shall not be transported.

**17.9** Suitable gas masks with eye shield shall be available within easy reach, wherever cylinders and containers are handled.

### **18. Records**

**18.1** Filling station shall maintain the following record in respect of each cylinder examined and tested for filling:

- a) Name of the manufacturer and the owner;
- b) Cylinder number;
- c) Specifications to which the cylinder conform;
- d) Date of original hydrostatic test;
- e) Test reports and certificates furnished by the manufacturer;
- f) Test pressure;
- g) Maximum working pressure;
- h) Water capacity in litres;
- j) Date of the last hydrostatic test;
- k) Tare mass of the cylinder;
- m) Variation, if any, in the tare mass marked on the cylinder and actual tare mass at the time of hydrostatic test;

- n) Type of the valve fitted;
- p) Type of the safety device, if fitted;
- q) Mass of the ammonia charged;
- r) Maintenance attended; and
- s) Remarks.

**18.1.1** Permission obtained from the statutory authority permitting the use of cylinder, shall be preserved till the cylinder is condemned.

## EXPLANATORY NOTE

For safe handling of cylinders containing liquid ammonia, one should be thoroughly conversant with the properties and characteristics of ammonia. There are several precautions and safe practices which are to be observed on account of the nature of ammonia and also because of the pressure to which cylinders are subjected.

Manufacturers, fillers, and users of the gas cylinders covered by this code should be familiar with the precautions laid down in this code in order to ensure safe and efficient operating conditions. For general information on different gases conveyed in cylinders, SP : 9-1973 'Technical data sheet for gases conveyed in cylinders' may also be referred to.

This standard was first published in 1979. The committee responsible for preparation of this standard decided to revise the same to bring this standard in line with the development made in the field of gas cylinder technology at the international level.

Other standards in this series, which have also been updated are as under:

- Part 1 Atmospheric gases
- Part 2 Hydrogen gas
- Part 3 High pressure liquefiable gases
- Part 4 Dissolved acetylene gas
- Part 5 Liquefied petroleum gas ( LPG )
- Part 6 Liquefied chlorine gas
- Part 8 Common organic refrigerant gases
- Part 9 Sulphur dioxide gas
- Part 10 Methyl bromide gas
- Part 11 Methyl chloride gas
- Part 12 Gases for medical use

Manufacture, possession and use of any gas when contained in cylinders in a compressed or liquefied form is regulated under the Gas Cylinders Rules 1981, of the Government of India as amended from time to time. Although the code has been prepared in consultation and agreement with the statutory authorities under these rules, should anything in the code conflict with the provisions of Gas Cylinder Rules 1981, the latter shall be adhered to.

In using this code, IS : 662-1980 'Specification for anhydrous ammonia (first revision)', which lists two grades of anhydrous ammonia shall be borne in mind.

The quantities in this standard have been expressed in technical metric units. However, in view of the introduction of International System ( SI ) units in the country, the relevant SI units and the corresponding conversion factors are given below for guidance:

Pressure —  $1 \text{ kgf/cm}^2 = 98.0665 \text{ kPa (kilopascal)} = 0.980665 \text{ bar}$   
 $= 0.980665 \text{ MPa (megapascal)}$

Stress —  $1 \text{ kgf/mm}^2 = 9.80665 \text{ N/mm}^2 \text{ (Newton per square millimetre)}$